DANMARKS NATIONALBANK

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Effects of increases in monetary policy rates

Since 2022, monetary policy rates have been increased significantly in a number of countries. Interest rate increases cool economic activity, and there are no indications that the effect on inflation and unemployment differs significantly between Denmark and the euro area. Danish households' and businesses' net interest payments rise after an interest rate increase, and higher interest payments seem to have contributed to reducing household consumption growth.

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Increases in monetary policy rates dampen inflation and activity

An interest rate increase dampens economic activity and inflation, and this effect comes with a lag. The higher interest rates since 2022 have thus contributed to stabilising the Danish economy. There are no indications that the effect of higher interest rates on inflation and unemployment differs significantly between Denmark and the euro area.

Interest rate increases mean higher net interest payments for businesses and households

Both interest income and expenses for businesses and households have risen since the monetary policy rate increases. While this has resulted in increased net interest payments for Danish households, euro area households have seen a decrease in their net interest payments. This is due to differences in balance sheet composition and interest rate pass-through.

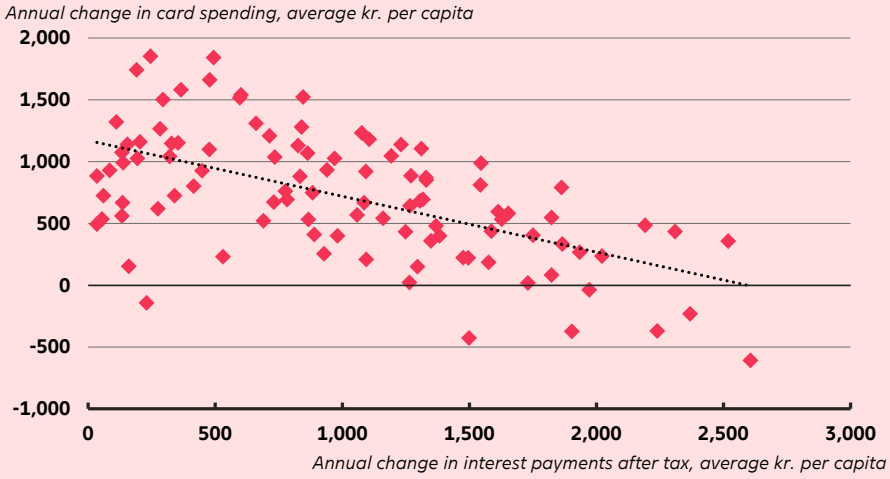
Higher interest payments dampen household consumption

Higher interest payments on debt are expected to dampen consumption, and consumption growth has been weakest in municipalities where household interest payments have increased the most. Realised capital gains from refinancing of fixed-rate mortgages only seem to have supported consumption to a modest extent.

Why is it important?

Danmarks Nationalbank is the monetary policy authority in Denmark and therefore sets monetary policy rates. As a result of the fixed exchange rate policy, this is done in order to maintain a fixed exchange rate of the krone against the euro. However, monetary policy rates have a significant impact on interest rates faced by households and businesses, and a change in monetary policy rates will therefore affect, for example, household consumption and business investment. Against this background, this analysis highlights how monetary policy affects the economy. Where possible, these effects are compared with the corresponding effects in the euro area. Danmarks Nationalbank's assessment of economic developments and its recommendations for economic policy depend on the effect of monetary policy in Denmark, as well as in the euro area.

Main chart: Consumption growth has been weakest in municipalities where quarterly interest payments have increased the most



Note: The chart is a scatter plot of the year-on-year change in the average amount per capita for card spending and after-tax interest payments for a specific municipality in each quarter from Q2 2022 to Q3 2023. All data points are divided into 100 equal-sized bins based on the change in interest payments, so that there are approximately the same number of observations in each bin. Adjustments are made for quarterly seasonal fluctuations within the year.
Source: Danmarks Nationalbank and Danske Bank.

Keywords

Monetary policy
Danish economy
Fixed exchange rate policy
Consumption
Interest rates
Households and businesses

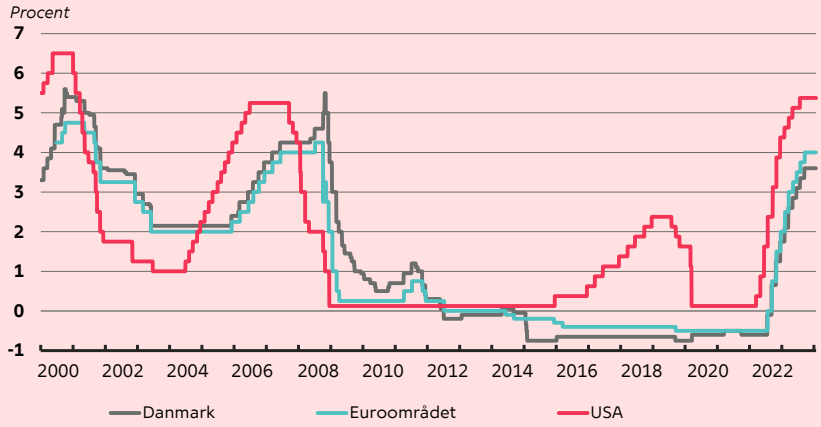
01

Increases in monetary policy rates dampen inflation and activity

Since 2022, central banks have tightened monetary policy significantly in many countries. This occurred after sharp increases in inflation. Against this background, it was necessary to dampen private sector demand in order to bring inflation back towards the central banks' targets, which are often expressed as annual consumer price inflation in the region of two per cent. Monetary policy has been tightened partly by central banks raising monetary policy rates (see chart 1), and partly by a number of central banks, such as the European Central Bank (ECB) and the US Federal Reserve (Fed), reducing holdings under the asset purchase programmes that, together with low interest rates, contributed to an accommodative monetary policy.

CHART 1

Monetary policy rates have increased significantly since 2022



Note: The chart shows Danmarks Nationalbank's certificates of deposit rate for Denmark and the midpoint of the Federal Reserve's target range for the Fed fund's rate for the US. For the euro area, the ECB's minimum bid rate for the main refinancing operations up to 14 October 2008 is used, after which the fixed rate for the ECB's main refinancing operations is used.
Source: Macrobond.

In Denmark, monetary policy rates have also been increased. This is a result of the fixed exchange rate policy, whereby Danmarks Nationalbank conducts monetary policy with the aim of maintaining a fixed exchange rate of the Danish krone against the euro. As a consequence, there is a close correlation between monetary policy rates in Denmark and the euro area, as shown in chart 1. In Denmark, the benchmark monetary policy rate has been raised by 4.2 percentage points since July 2022, while the ECB has raised its rate by 4.5 percentage points over the same period. The slightly smaller interest rate

increases in Denmark reflect that there has been a strong demand for the Danish krone.

Unlike the ECB, Danmarks Nationalbank has not utilised quantitative easing. However, the fixed exchange rate policy implies that the increase in market rates resulting from the ECB's reversal of quantitative easing may also have led to higher Danish market rates.[1] Although the ECB and Danmarks Nationalbank first raised monetary policy rates in July 2022, the ECB began to tighten monetary policy from an accommodating starting point as early as the end of 2021. This was done by the ECB indicating its intentions to taper the positive net purchases of bonds under the asset purchase programmes. At the June 2022 monetary policy meeting, the ECB announced that it planned to raise monetary policy rates at the following meeting the next month.

Monetary policy is transmitted to the economy through multiple channels

A monetary policy tightening initially affects banks and financial markets. In this way, the tightening will have an impact on the interest rates faced by households and businesses. The transmission of monetary policy rates to households and businesses' retail interest rates takes place via the Danish money market, bond market and banks, as described in more detail in Danmarks Nationalbank (2024).

The private sector is affected by tighter monetary policy through multiple channels; see box 1. Part of the transmission depends on the change in the nominal interest rate, which directly affects the size of interest payments made by households and businesses. Other parts are more dependent on the change in the real interest rate, i.e. the nominal interest rate adjusted for expected inflation. An increase in the real interest rate makes it more attractive to postpone consumption and investments.

[1] Quantitative easing includes, for example, asset purchase programmes such as APP and PEPP. See Jensen et al. (2017) for an analysis of how the ECB's asset purchase programmes affect market rates in Denmark.

BOX 1

Monetary policy transmission channels

Monetary policy affects both consumption and investment through multiple channels. This box describes the main channels of monetary policy transmission, focusing on the impact of a monetary policy rate increase on household consumption and business investment. The monetary policy transmission mechanism described here influences the economy regardless of how the central bank has influenced interest rates in the economy. For example, the central bank may have changed its monetary policy rate or influenced market rates by communicating its expectations of future interest rate changes or using quantitative easing.[1]

Direct effects
Interest rate increases affect household consumption *directly* through both the *intertemporal substitution channel* and through the *cash-flow channel.*

The intertemporal substitution channel works by encouraging savings through a higher real interest rate, making it less attractive to consume today rather than later. Similarly, an increase in the real interest rate will increase the cost of having capital tied up in the business, making it more attractive to postpone investments rather than investing today.

The cash-flow channel can both contribute to increasing or reducing households' consumption possibilities, depending on whether households have large deposits or a lot of debt, and how quickly interest rates on deposits and loans react. For households that are, for example, liquidity constrained or inattentive to how inflation will affect their consumption options in the future, the nominal interest rate will be important for the transmission through this channel.[2] The cash-flow channel also affects businesses' investments by influencing businesses' net interest payments depending on the company's balance sheet composition.

Indirect effects
The *indirect* – or general equilibrium – effects affect households and businesses through the impact of interest rate increases on other parts of the economy and are divided into four channels:

The wealth channel. Through the wealth channel, rising interest rates will lead to falling asset prices and thus lower household wealth. Lower wealth will cause the household to reduce consumption. However, part of this effect can be counteracted by the fact that the need for savings, for example for home purchases, is also reduced by falling house prices. The overall effect of the wealth channel thus depends on how wealth is distributed across the population. In parallel with this effect for households, businesses' assets will also fall in value, which in isolation will contribute to lower business investment.

The home equity channel. In addition to the fall in asset prices limiting households' ability to borrow against assets such as their homes, household consumption can also be affected through a specific home equity channel. Through this channel, household consumption can potentially increase as a result of a rise in interest rates, as the Danish mortgage credit system allows for refinancing of fixed-rate mortgage debt at a higher interest rate in exchange for a reduction in the total outstanding debt. With additional borrowing against the property at the same time as refinancing, the homeowner can access liquidity to support consumption. The consumption effect through this channel is not necessarily symmetrical for interest rate decreases and increases, as interest rate decreases also allow for additional borrowing in connection with refinancing. This channel is arguably more important for households than for businesses.[3]

The Fisher channel. Monetary policy rate increases operate through this channel by lowering inflation and thereby increasing the real value of the borrower's debt, which is offset by an increase in the real value of the saver's wealth. This channel affects businesses in a similar way.

The exchange rate channel. Interest rate increases by the ECB increase the value of the krone against foreign currencies, such as the dollar, via an appreciation of the euro. This makes foreign goods relatively cheaper. For households, it increases consumption possibilities, while for businesses it can make it more difficult to export goods abroad.[4]

The monetary policy transmission described through the channels above illustrates that an interest rate increase will affect households differently depending on, for example, their balance sheets and income composition.[5] This matters because different households react differently. For example, borrowers often have a higher marginal propensity to consume than savers. An increase in interest rates that leads to a redistribution from borrowers to savers will thus have real economic effects in the form of a decrease in consumption.[6]

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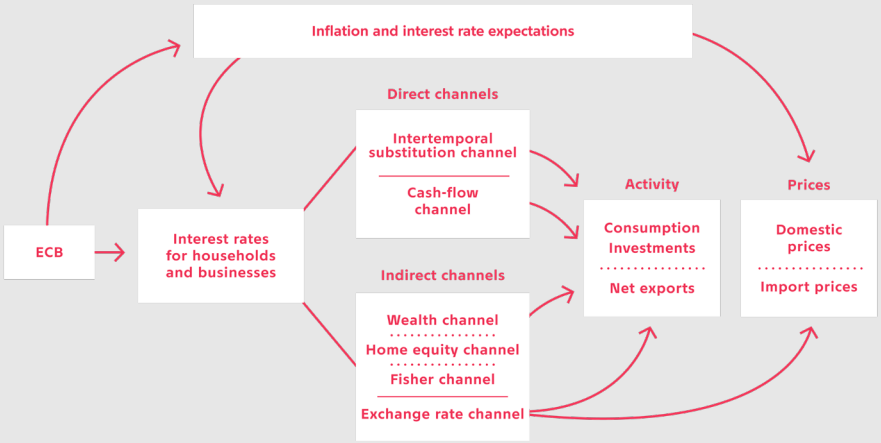
The overall effect of interest rate increases on consumption and investment is affected by all the individual channels. In addition, the overall effect of interest rate increases is also affected by households' and businesses' expectations of the duration of interest rate increases. The longer the interest rate increase is expected to last, the greater the effect an interest rate increase will generally have. Even interest rate increases that are expected to be temporary can affect both output and inflation due to price inertia, or if households and businesses are liquidity constrained or have myopic preferences and thus cannot or will not smooth out a temporary drop in income.

CHART

The monetary policy transmission channels



[1] See Kaplan et al. (2018), Auclert et al. (2020) and Auclert et al. (2021) for detailed expositions of the different transmission channels.
[2] For households that are, for example, liquidity or credit constrained, the actual net interest expense, and thus the nominal interest rates, can be the decisive factor for the consumption decision in the short term; see e.g. Kaplan and Violante (2014). Furthermore, households that are inattentive to price developments may tend to react primarily to nominal variables, as these are directly observable, whereas real net interest payments and interest rates require knowledge of price developments. Such a reaction pattern is often referred to as money illusion; see e.g. Shafir et al. (1997) or Fehr and Tyran (2001).
[3] Empirical studies have found consumption effects through the home equity channel in connection to lower interest rates; see Andersen and Leth-Petersen (2021) and Bhutta and Keys (2016).
[4] Note that the exchange rate channel also affects the domestic value of assets and liabilities held in foreign currency (non-euro).
[5] See e.g. Holm et al. (2021) or Andersen et al. (2023a).
[6] See e.g. Crawley and Kuchler (2023), who estimate that an interest rate increase of one percentage point leads to a decrease in consumption of 0.26 per cent solely as a result of redistribution between households with different marginal propensities to consume.

Not trivial to measure the effect of monetary policy

Inflation has fallen across countries after central banks started tightening monetary policy; see chart 2. At the same time, growth in economic activity has slowed down (see chart 3), albeit this occurred before the monetary policy tightening. These two movements would seem to indicate that tighter monetary policy reduces inflation and has a limited effect on activity. However, both inflation and economic activity are continuously affected by a wide range of factors beyond monetary policy. For example, the sharp rise in inflation in 2021-

22 largely reflected factors other than monetary policy.[2] Similarly, the large fluctuations in activity in 2020-21 should be seen in the light of Covid lockdowns and relief packages.

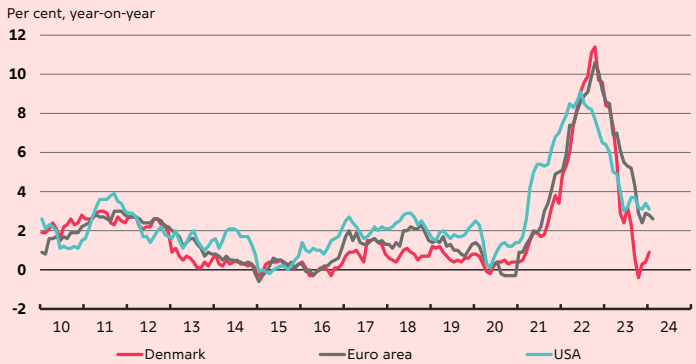
Central banks like the ECB set monetary policy rates based on an assessment of how the economy will develop in the near future. This relationship between interest rates and inflation expectations means that it is far from trivial to assess the effect of a monetary policy rate change on macroeconomic developments. For example, the ECB will typically raise interest rates if inflation is expected to exceed the two per cent target. This can mean that in some cases an interest rate increase is followed by an increase in inflation, whereas in the absence of the rate increase, the increase in inflation would have been higher.

It is therefore necessary to isolate the effect of an interest rate increase on inflation from the fact that the interest rate increase itself reflects that the central bank's expects relatively high inflation in the near future. If it is ignored that an interest rate increase is a response to underlying inflationary pressures, its effect will be underestimated. In a hypothetical example where the central bank succeeds in completely stabilising inflation, it may appear that monetary policy rates do not affect inflation at all. However, this would be a fallacy, as stable inflation reflects the fact that monetary policy has prevented all fluctuations in inflation.

As a result of the fixed exchange rate policy, as described above, Danmarks Nationalbank does not set monetary policy rates based on a forecast of economic developments. However, there is a significant correlation between the Danish economy and the euro area economy. A period of strong demand and the prospect of rising inflation in the euro area will often coincide with similar developments in Denmark. Therefore, the ECB's interest rate increases, which as a result of the fixed exchange rate policy are matched by interest rate increases from Danmarks Nationalbank, will often take place during periods when there are also outlooks for strong activity and rising inflation in Denmark. The effect of interest rate increases on inflation and activity in Denmark will therefore also be underestimated if this estimate is solely based on the observed correlation between monetary policy rates and macroeconomic developments.

CHART 2

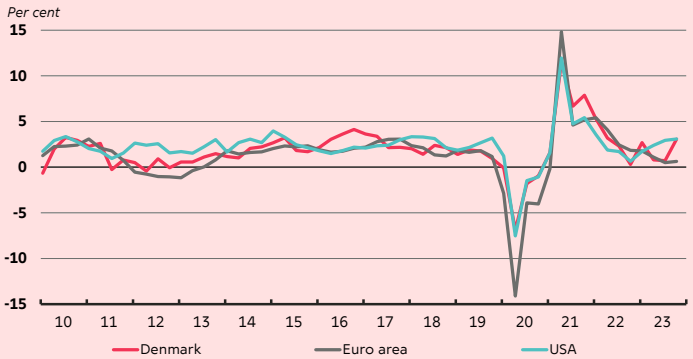
Inflation has decreased significantly since 2022



Note: The chart shows consumer price inflation.
Source: Macrobond.

CHART 3

GDP growth has slowed since 2021



Note: The chart shows the year-on-year GDP growth rate.
Source: Macrobond.

[2] See Harr and Spange (2023) for a discussion of the drivers behind the large increase in inflation.

Tighter monetary policy slows activity and price developments

In order to determine the actual influence of monetary policy on macroeconomic outcomes, economic research has developed various methods to isolate the pure causal relationship from monetary policy to activity and prices; see box 2. The results from these methods generally show that a monetary policy rate increase weakens activity, but that it takes time for the full effect to materialise.[3] This is also the case for Denmark; see Larsen and Weissert (2024).

The slowdown in activity reflects that monetary policy rate increases affect the interest rates faced by households and businesses. Investment and consumption respond to higher interest rates through the monetary policy transmission channels discussed in box 1. A tightening of monetary policy typically leads to a widening of credit spreads, such that the cost of borrowing increases more than the increase in monetary policy rates itself would suggest.[4] Research also indicates that investors become less inclined to take on risk. Such tightening of financial conditions reinforces the effect on economic activity.[5]

Research also shows that monetary policy tightening has a dampening effect on inflation.[6] This is confirmed by Larsen and Weissert (2024) in a Danish context. The fall in inflation is partly due to a slowdown in demand, and thereby activity. This affects inflation for three reasons. Firstly, lower demand leads to a reduction in businesses' marginal costs when they produce less. Secondly, lower demand can result in changes to competition or more price-sensitive households, which affects businesses' price setting. As the business adjusts its prices, this is gradually passed on to lower consumer prices. Thirdly, a lower demand for labour can weaken wage growth.

In addition, monetary tightening in the euro area will, all else being equal, strengthen the euro against other currencies. As the krone is fixed to the euro, the effective krone rate will also strengthen and dollar-denominated goods (e.g. oil and food) will become cheaper. This reduces import prices and gradually passes on to consumer prices.[7] At the same time, the stronger krone will make Danish goods more expensive in export markets outside the euro area, further weakening demand.

The effect of monetary policy tightening since 2021 may be affected by particular factors

Although research shows that monetary policy tightening generally dampens activity and inflation, there are several factors that may have reduced or partially delayed the effect of recent interest rate increases. For example, households in several countries have had significant liquidity assets at their disposal as a result of the compensation schemes that were implemented, while spending possibilities were restricted by lockdowns related to the Covid-19 pandemic.

Conversely, some circumstances imply that monetary policy may have had a greater effect than usual. For example, the rise in inflation has been so strong that there has been a risk that households and businesses might lose confidence that central banks would maintain their focus on low inflation. An important contribution of the monetary policy tightening has therefore been to maintain the credibility of the central banks' target of bringing inflation back to around

[3] See e.g. Coibion (2012) or Ramey (2016) for a literature review.
[4] See e.g. Caldara and Herbst (2019), Miranda-Agrippino and Ricco (2021), Badinger and Schiman (2023) and Larsen and Weissert (2024).
[5] The tightening of financial conditions is consistent with the so-called financial accelerator; see Bernanke and Gertler (1995) and Bernanke et al. (1999).
[6] Early empirical studies of the effect of monetary policy on inflation, where the effect of monetary policy is isolated using a Cholesky decomposition (see box 2), generally find that the price level first rises and then falls as a result of a monetary policy rate increase. This phenomenon is referred to in the literature as a "price puzzle".
[7] See Kristoffersen and Spange (2016).

two per cent; see Amatyakul et al. (2023). This suggests that the recent monetary policy tightening has been particularly important to inflation developments.

BOX 2

Methods for assessing the effects of monetary policy

Changes in monetary policy rates will typically reflect that the ECB reacts to economic developments in the euro area in order to keep inflation at two per cent. Outlooks of inflation exceeding the ECB's target will often result in tighter monetary policy, while outlooks of low inflation will cause the ECB to ease monetary policy. Therefore, a simple analysis of the relationship between monetary policy rates and inflation will not be able to separate the effect of a monetary policy rate change on inflation from the fact that the outlook of higher inflation causes the ECB to raise interest rates.

Thus, there is a clear *causality problem*: Interest rates affect inflation in the future, but inflation expectations also affect how the central bank sets interest rates. A simple approach that does not consider that causality works both ways will consistently underestimate the effect of monetary policy rate increases on inflation. It is therefore necessary to identify exogenous interest rate changes that cannot be attributed to the expected reaction of the ECB to economic developments, so-called monetary policy shocks, in order to estimate the causal effect of an interest rate change on the economy.

Identification of monetary policy shocks

There are several approaches to identifying monetary policy shocks, reflecting a very extensive body of research.[1] One of the early approaches identifies shocks by assuming how quickly macroeconomic variables such as output and prices respond to interest rate changes using a so-called Cholesky decomposition. Here, monetary policy shocks are typically isolated by the assumption that output and prices do not respond to a monetary policy rate change immediately (usually within a quarter or a month).[2] The assumptions of the Cholesky decomposition can be relaxed using sign restrictions on the effects of a monetary policy shock on macroeconomic variables. For example, Uhlig (2005) identifies monetary policy shocks by assuming that they cause interest rates and inflation to move in opposite directions.

Other approaches isolate monetary policy shocks from macroeconomic developments by using data that are not directly included in the empirical model. This method does not make any assumptions about how a monetary policy shock affects economic activity and inflation, but only assumptions about what part of interest rate changes can be labelled as a monetary policy shock. An influential study by Romer and Romer (2004) identifies monetary policy shocks in the US by controlling for the Federal Reserve's internal forecasts of GDP growth and inflation. This method is referred to as the narrative approach.[3] Monetary policy shocks are assumed to be the variation in monetary policy rates that cannot be explained by the Federal Reserve's own forecasts of economic developments.

An approach often used in the recent literature isolates monetary policy shocks using high-frequency changes in market rates from a few minutes before a monetary policy announcement to a few minutes after.[4] These high-frequency changes thus measure the deviation between market participants' expectations of the policy rates that will be announced and the actual policy rates that end up being announced. The identifying assumption is that the change in market rates from a few minutes before announcements to a few minutes after is solely due to the monetary policy decision taking the market by surprise. The change in market rates within this short interval is thus assumed to be independent of the economic developments to which the central bank responds and therefore expresses the size of the monetary policy shock.

Structural models can also be used to analyse the effects of monetary policy. Compared to the above approaches, structural models are characterised by utilising economic theory to a greater extent, which restricts how macroeconomic variables depend on each other. In this way, monetary policy shocks are also identified using the theoretical structure. For example, New Keynesian DSGE models typically specify a monetary policy reaction function of how central banks react to economic developments, known as the Taylor rule. Monetary policy shocks are defined in this approach as deviations from the Taylor rule.[5]

Because structural models rely heavily on economic theory, monetary policy will to some extents have the expected effects on activity and inflation by design. Therefore, the models cannot be used to evaluate whether monetary policy dampens activity and prices. However, they are well-suited to examine different channels through which monetary policy works, and they can also be used for scenario analyses of, for example, alternative interest rate paths.

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[1] See Coibion (2012), Ramey (2016) and Wolf (2020) for a thorough review and discussion of identification methods.
[2] See e.g. Sims (1986) and Christiano et al. (1999).
[3] Aruoba and Dreschel (2023) further developed the method in Romer and Romer (2004). The approach has also been adopted to other countries such as the UK (Cloyne and Hürtgen, 2016).
[4] See e.g. Kuttner (2001), Gürkaynak et al. (2005), Caldara and Herbst (2019), Jarocinski and Karadi (2020), Cesa-Bianchi et al. (2020), Miranda-Agrippino and Ricco (2021), Badinger and Schiman (2023) and Swanson (2023). The approach can also be applied to other types of monetary policy communication beyond announcements of monetary policy decisions such as speeches by central bank steering committee members; see e.g. Swanson (2023).
[5] See e.g. Smets and Wouters (2003), Del Negro et al. (2015) and Coenen et al. (2019).

No indications of significant differences in the effects of interest rate increases on unemployment and inflation in the euro area and Denmark

Although there is a close correlation between monetary policy rates in Denmark and the euro area, a monetary tightening of a given size will not necessarily have the same effect on the Danish economy as it does on the euro area economy. Similarly, there may be differences across individual euro area countries. The differences reflect the fact that monetary policy transmission depends on economic and financial structures , which vary across countries. For example, differences in how houses are financed lead to differences in how quickly and to what extent a change in interest rates affects households. Similarly, the relationship between activity, inflation and employment depends, for example, on the structure of the labour market.

There are no indications that the effect of monetary tightening on important macroeconomic variables such as inflation and unemployment differs significantly between Denmark and the euro area. This can be seen by estimates of how inflation and unemployment are affected by a monetary policy shock by the ECB; see box 3. Due to the fixed exchange rate policy, the exercise implies that the ECB's interest rate increase is mirrored by a roughly equivalent interest rate increase from Danmarks Nationalbank. A fairly uniform response to a monetary policy tightening in Denmark and the euro area means that a monetary policy tightening by the ECB does not necessitate a Danish fiscal policy response.[8]

[8] See Spange (2022) for a discussion of the interplay between monetary and fiscal policy in Denmark.

BOX 3

Not significant differences in effects of monetary policy between Denmark and the euro area

An empirical analysis has been conducted to shed light on how inflation and unemployment in Denmark and the euro area are affected by a monetary policy shock by the ECB. Due to the fixed exchange rate policy, the exercise implies that the ECB's interest rate increase is mirrored by a roughly equivalent interest rate increase from Danmarks Nationalbank. The monetary policy shocks are identified by using high-frequency changes in short-term European overnight index swap rates (OIS rates) from a few minutes before the ECB's announcement of monetary policy decisions to a few minutes after, following the methodology described by Larsen and Weissert (2024) and based on Jarocinski and Karadi (2020).

In order to estimate the effects of the above-mentioned monetary policy shocks by the ECB, a Bayesian local projections model (BLP model) is used. The model is a flexible, data-based approach wherein economic theory is used to motivate which macroeconomic variables to include in the model, but not to determine causal relationships between them. The response of the variables to a monetary policy shock is thus freely estimated based on the data.

The model is estimated separately for Denmark and the euro area on monthly data from January 2003 to February 2023. The Danish model includes the Danish three-month money market interest rate, industrial production, unemployment, monthly HICP inflation, monthly HICP energy inflation and an indicator of global financial conditions measured by the spread between BAA-rated US corporate bonds and 10-year US government bonds. When modelling the euro area, all variables are replaced with equivalent euro area variables except for the US corporate bond spread. As control variables, 12 lags of all variables are included. The money market interest rate is instrumented with the monetary policy shocks described above.

The results from the model are presented in charts A and B, which show the response of inflation and unemployment to a monetary policy shock by the ECB. The shock is scaled to cause the money market interest rate to rise immediately by one percentage point, after which the rate gradually returns to its starting point. The effects in the charts should be interpreted as the deviation in inflation and unemployment measured in percentage points from their trend.

The model's estimates indicate that tighter monetary policy works as expected in both Denmark and the euro area. Inflation is thus dampened, while unemployment increases. The full effect of a monetary policy tightening occurs with a lag. In addition, the model indicates that there are no significant differences in the effects between Denmark and the euro area. Unemployment is affected similarly, while inflation appears to fall slightly less in Denmark. However, the effects are on inflation do not differ at statistically significant level.

It is thus important to note that the estimation is subject to considerable statistical uncertainty, which is expressed by the uncertainty bands shown. The effects are in line with what others have found for the UK, Sweden and the euro area using similar methods.[1] However, the ECB finds smaller effects for the euro area using five different approaches, which are mainly based on structural modelling; see Lane (2023).

Furthermore, the effect sizes from the BLP model cannot be multiplied by the cumulative interest rate increase since 2022 to quantify the total effects of the recent monetary policy tightening. This reflects, among other things, that the effect of an announcement followed by a subsequent interest rate change, which the ECB has used to a large extent, may differ from the effect of an unexpected interest rate increase which is the shock in the model.

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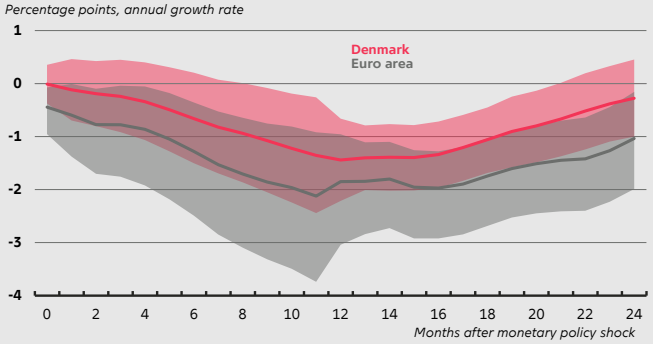
CHART A

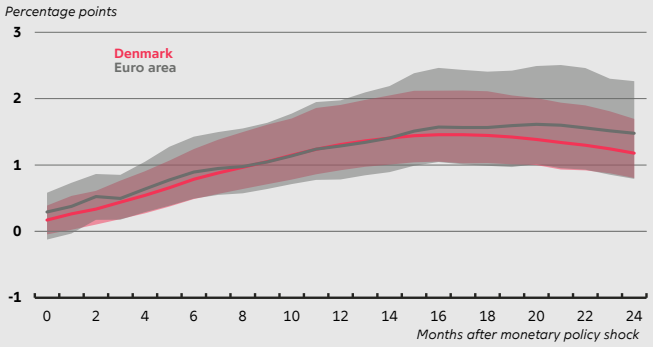
Monetary tightening by the ECB leads to a drop in inflation in Denmark and the euro area...



Note: The monthly inflation response is converted to annualised rates. Solid red lines indicate median estimates, while the shaded areas indicate the Bayesian 90 per cent uncertainty bands of the estimates.
Source: Own calculations.

CHART B

...and unemployment is rising



Note: Solid red lines indicate median estimates, while the shaded areas indicate the Bayesian 90 per cent uncertainty bands of the estimates.
Source: Own calculations.

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There may also be non-linearities associated with large interest rate changes, and the ongoing unwinding of the asset purchase programmes also contributed to the overall monetary policy tightening. An overall assessment of the effects of the monetary policy tightening would require a structural model that specifies how households and businesses react to unexpected as well as expected monetary policy tightening, and the unwinding of asset purchase programmes.[2] This is beyond the scope of this analysis.

[1] See e.g. Cesa-Bianchi et al. (2020), Laséen (2020), Jarocínski and Karadi (2020) and Badinger and Schiman (2023).
[2] See e.g. Crump et al. (2023), Amatyakul et al. (2023) and Caravello et al. (2024).

02

Interest rate increases mean higher net interest payments for businesses and households

When Danmarks Nationalbank raises monetary policy rates, it affects banks' deposit and lending rates, as well as short-term mortgage rates. For bank interest rates, this means that a monetary policy rate increase results in higher financing costs for banks, while mortgage rates rise in line with market rates as a consequence of the Danish market-based mortgage system. The extent to which long-term mortgage rates react depends largely on whether the interest rate increase is expected to be of a longer duration.[9] The effect of Danmarks Nationalbank's interest rate increases on the interest rates faced by households and businesses is known as the interest rate pass-through.

This chapter focuses on how interest rate changes affect the net interest payments of non-financial businesses and households. A net interest payment is defined as businesses' and households' interest payments minus their interest income. Changes in net interest payments are one of the channels through which monetary policy can influence consumption and investment; see box 1. At the same time, it is a channel that can be analysed directly based on data, whereas it is less obvious how, for example, the significance of the intertemporal substitution channel should be measured.

However, it's important to emphasise that the cash-flow channel is not necessarily the most important transmission channel. As the channel reflects a redistribution of cash flows across foreign actors, households, businesses and banks, its strength depends largely on how the different actors react to changes in their individual net interest payments. The potential consumption effects of changing net interest payments are discussed at the end of the chapter and elaborated on in the following chapter, "Higher interest rates dampen household consumption".

Deposit rates have increased more for businesses in Denmark than in the euro area

Since Danmarks Nationalbank and the ECB began raising monetary policy rates in July 2022, interest rates on businesses' outstanding loans from credit institutions and on their deposits have increased; see charts 4 and 5. The average borrowing rate has generally followed the development in the euro area closely and has increased marginally more during the current tightening period.

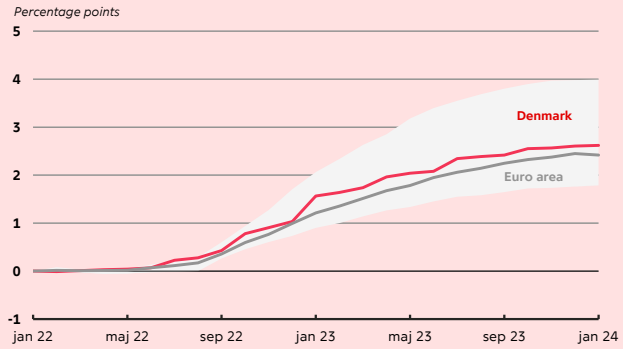
Deposit rates for businesses have increased significantly more in Denmark than in the euro area; see chart 5. However, this should be seen in light of the fact that the starting point for businesses' deposit rates was lower in Denmark than in the euro area, with an average deposit rate of -0.7 per cent compared to -0.1

[9] See e.g. Mandsberg et al. (2016) or Drejer et al. (2011) for further discussion of the role of financial markets in monetary policy transmission. Also see Danmarks Nationalbank (2024) for a review of the transmission of monetary policy rate increases to the money and bond markets.

per cent in the euro area at the beginning of 2022. Deposit rates in Denmark have subsequently overtaken deposit rates in the euro area.

CHART 4

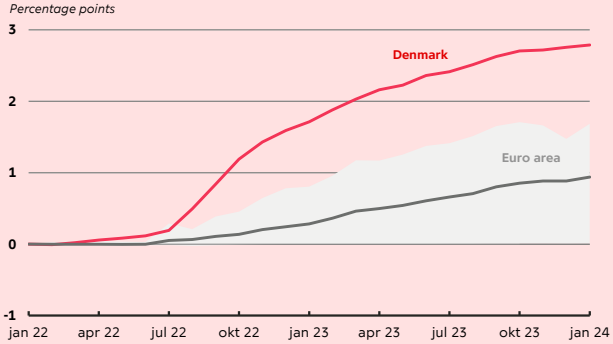
The average interest rate on outstanding businesses' loans has risen slightly faster in Denmark than in the euro area



Note: Cumulative changes in the interest rate on outstanding loans for non-financial businesses since January 2022. The shaded area indicates the spread across countries within the euro area (Greece, Croatia, Luxembourg and Malta are not included).
Source: Danmarks Nationalbank, ECB and own calculations.

CHART 5

Businesses' deposit rates have risen significantly faster in Denmark than in the euro area



Note: Cumulative changes in the interest rate on day-to-day deposits for non-financial businesses since January 2022. The chart does not include the interest rate development for other deposit types such as time deposits, where deposits are tied up for a period of time. The shaded area indicates the spread across countries within the euro area (Greece, Croatia, Luxembourg and Malta are not included).
Source: Danmarks Nationalbank, ECB and own calculations.

Businesses' net interest payments have increased the most in Denmark

Rising lending and deposit rates pass through to businesses' net interest payments, which is reflected in their interest burden; see chart 6. The interest burden is defined as interest expenses less interest income as a share of gross value added. After the monetary policy rate increases in 2022, the interest burden has increased for businesses in both the euro area and Denmark, but the increase is greatest among Danish businesses. The actual effect of the higher interest rates on businesses' net interest payments can be assumed to be less than chart 6 indicates. This is because businesses to a certain extent hedge their interest rate risk using interest rate swaps, and such income from derivatives is not included in the data basis of the chart.[10]

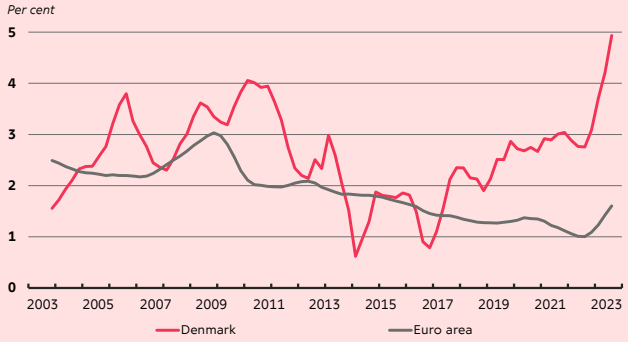
The larger increase in the interest burden for Danish businesses hides the fact that both their interest expenses and income have increased more than for businesses in the euro area. This should be seen in light of the fact that differences in businesses' interest burden not only reflect differences in the interest rate pass-through in Denmark and the euro area, but also differences in the businesses' balance sheet composition. Chart 7 shows businesses' interest-bearing assets and liabilities in Q1 2022 in both Denmark and the euro area.[11] The chart illustrates that higher interest income among businesses in Denmark must be solely due to the fact that the interest rate increases for deposits among

[10] The exact extent of Danish businesses' hedging is not known, but a recent study finds that about half of non-financial companies with floating-rate debt in the euro area, the UK and the US hedge their interest rate risk; see Banerjee et al. (2023).
[11] Gross debt only includes interest-bearing components on the balance sheets of non-financial businesses. The Danish business sector also owns significant non-interest-bearing assets such as shares and assets owned through affiliated holding companies.

Danish businesses have been greater than in the euro area, as Danish businesses have lower deposits overall than businesses in the euro area; see chart 7.

CHART 6

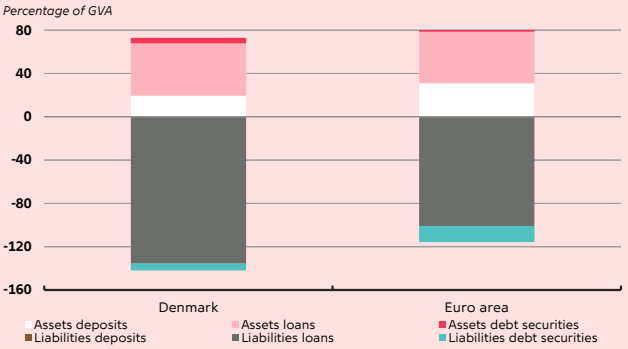
The interest burden for Danish businesses has increased more than in the euro area



Note: The businesses' interest burden is defined as net interest expenses as a percentage of gross value added (GVA). Interest expenses and interest income are before FISIM allocations. The figures do not include any income and expenses from interest rate derivatives. The interest burden is shown as a 12-month moving average.
Source: Danmarks Nationalbank, ECB and own calculations.

CHART 7

Danish businesses have overall more debtthan businesses in the euro area



Note: Interest-bearing components of non-financial businesses' gross balance sheets in Q1 2022. Other components such as listed and unlisted shares are disregarded.
Source: Danmarks Nationalbank, ECB and own calculations.

Despite rising interest income, the net interest burden for Danish businesses has increased overall. This should be seen in light of the fact that their gross debt exceeds deposits; see chart 7. Danish businesses' gross debt to GVA ratio is approximately 26 percentage points higher than for businesses in the euro area (142 per cent and 116 per cent of GVA, respectively). As a result, interest payments have increased more for businesses in Denmark than for businesses in the euro area, even though lending rates have increased almost equally in Denmark and the euro area. Chart 7 includes businesses' total gross debt, of which loans by domestic mortgage lenders in Denmark and the euro area constitutes 60 per cent and 39 per cent of GVA, respectively.

In both Denmark and the euro area, two-thirds of businesses' gross debt is debt to other sectors than the MFI sector, including to intra-group entities in Denmark and abroad. This means that part of the interest expenses could potentially be to a subsidiary or parent company. The same applies to businesses' interest income, which, in addition to interest on bank deposits, covers interest income from loans to other businesses, including intra-group loans. However, intra-group payments of interest expenses do not necessarily have the same impact on businesses' liquidity as interest payments to a bank, for example. This is because interest expenses for intra-group payments can be reversed internally within the group as needed. Furthermore, an increase in interest rates will not affect the business sector's total net interest payments for the part of the debt owed to other companies.

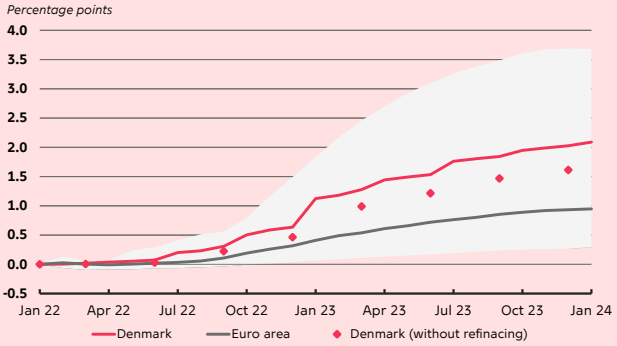
Larger increase in deposit and lending rates among Danish households

The increases in monetary policy rates have also been reflected in higher interest rates on households' loans from banks and mortgage credit institutions, as well as on their bank deposits; see charts 8 and 9. The charts also show that the pass-

through in Denmark has been stronger than the average within the euro area.[12] However, this should be seen in light of the fact that the starting point for deposit rates in particular was lower in Denmark, where banks had largely introduced negative interest rates.

CHART 8

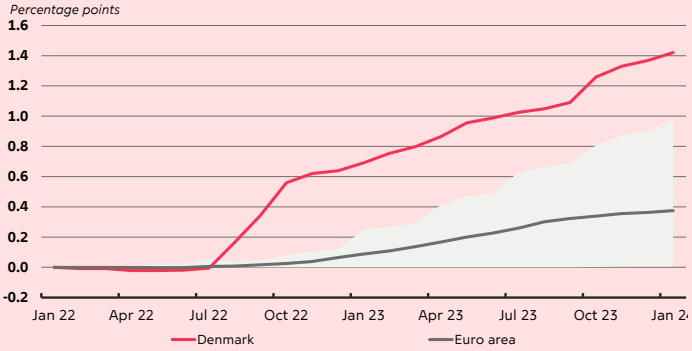
The interest rate on total outstanding debt has risen faster in Denmark than in the euro area



Note: Changes in percentage points since January 2022 for the interest rate on total outstanding household debt. The shaded area indicates the spread within the euro area (Greece, Croatia, Luxembourg and Malta are not included).
Source: Danmarks Nationalbank and the ECB.

CHART 9

Deposit rates for households have also risen faster in Denmark than in the euro area



Note: Changes in percentage points since January 2022 for the interest rate on on-demand deposits for households. The shaded area indicates the spread within the euro area (Greece, Croatia, Luxembourg and Malta are not included).
Source: Danmarks Nationalbank and the ECB.

The fact that the average interest rate on total lending to households has increased more in Denmark than in the euro area reflects, among other things, that the Danish market-based mortgage credit system has supported the interest rate pass-through to new lending. At the same time, Danish households have utilised the possibility in the Danish mortgage credit system to refinance fixed-rate mortgage loans in exchange for a potential reduction in their outstanding debt.[13] This has contributed to the fact that the interest rate pass-through on existing loans has been stronger in Denmark than in the euro area.[14] Chart 8 reflects both, as it shows the interest rate pass-through to all outstanding debt, including new loans. Chart 8 also illustrates how refinancings in isolation has contributed to the interest rate pass-through in relation to the interest rate on outstanding debt.[15]

Both interest rates on new and existing loans are important for the transmission of monetary policy. The interest rate on new lending is particularly important for developments in the housing market, as it is included in the initial instalment when buying a home and therefore affects homebuyers' willingness to pay. Similarly, interest rates on new loans can affect the purchase of larger consumer goods such as cars. However, the consumption effect of an interest rate increase

[12] The charts also show that there is considerable variation in the speed of the pass-through within the euro area. Interest rates on loans to households have not increased more in Denmark than in the euro area country where interest rates have increased the most.
[13] See Andersen et al. (2024) for more details on Danish households' refinancing of mortgage debt when interest rates rise.
[14] However, as many households have reduced their outstanding debt in connection with conversions, the pass-through to the total interest expenses on outstanding debt will be less than the pass-through to the interest rate itself.
[15] See Danmarks Nationalbank (2024) for more details on recent developments in household interest rates.

also depends on the interest rate on the total outstanding debt, as interest rate increases on existing debt are directly included in household budgets, even if households do not take on new debt.

On average, interest rate rises increase households' net interest payments in Denmark, but reduce them in the euro area

Just like for businesses, changes in interest rates will affect households' net interest payments. The effect can be quantified by the unhedged interest rate exposure (URE), which describes the net effect from household's interest-bearing assets and debt, see Auclert (2019). Chart 10 shows that URE for Danish households on average is negative, while euro area households on average have a positive URE.[16] However, the URE of Danish households is within the range of the individual euro area countries and, for example, the URE of Dutch households is more negative than that of Danish households. A positive URE for households in the euro area means that, on average, they will experience increased net interest income following monetary policy rate increases, while households in Denmark on average will experience increased net interest expenses.

URE only includes asset and liability components where the interest rate will be affected by a monetary policy rate change within one year. This means, for example, that the debt side only includes variable-rate loans, while the main asset component is deposits.[17] Households' fixed-rate loans are not included, even though, as shown in chart 8, Danish households can choose to refinance their mortgage debt at a higher interest rate in exchange for lower outstanding debt.

Furthermore, the considerable assets of Danish households, for example in pension savings, are also not included in the URE. Danish households' average net financial assets are among the highest in the EU, and for many households, the return on pension assets exceeds their interest payments; see Andersen et al. (2023b). Although pension assets are relatively illiquid in the short term and therefore not included in URE, pension returns can be an important element in households' longer-term consumption decisions. It may also be important for understanding the implications of the differences in URE between countries if, for example, households in the euro area are more likely to save for pensions in liquid interest-bearing claims, which are included in URE.

During periods of monetary policy rate increases, the interest burden for households rises in Denmark, but decreases in the euro area

In chart 10, the households' unhedged interest rate exposure is measured in 2021, but chart 11 also shows that Danish households' interest burden has historically increased in periods when interest rates have been rising. The interest burden is the ratio of households' interest payments less their interest income relative to their gross disposable income.[18] The increase in the interest burden reflects that the total debt of Danish households significantly exceeds their bank deposits. Furthermore, lending rates in Denmark have risen faster than deposit rates since 2022.

However, the large interest rate increases since 2022 have not, so far, had the same direct impact on household budgets as when rates were raised in 2006-09. This reflects, among other things, the fact that Danish households have significantly reduced their debt-to-income ratio since the financial crisis.[19] The

[16] The ECB finds similar results for the euro area; see de Bondt et al. (2023).
[17] See box 3 in Bovin et al. (2024) for a more in-depth look at the concept. All variable-rate loans are included regardless of their interest rate fixation period for comparability across data sources.
[18] Gross disposable income is defined as gross income after tax but excluding the calculated rental value ofone's own property.
[19] See e.g. Hviid and Kuchler (2017).

effect differs from the euro area, where fluctuations in interest rates only have a limited impact on households' net interest payments. This is primarily due to the fact that households in the euro area have less debt than Danish households. In addition, households in the euro area have larger deposits than households in Denmark.

The cash-flow channel may be stronger in Denmark than in the euro area

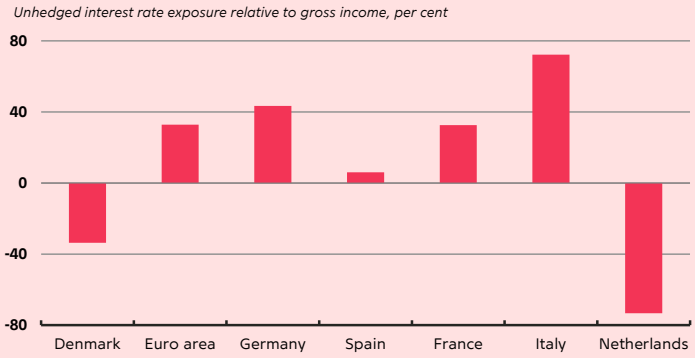
Charts 10 and 11 suggest that monetary policy rate increases via the cash-flow channel have a greater dampening effect on activity in the Danish economy than in the euro area. However, the fact that URE is positive for euro area households and that their interest burden tend to fall during periods of monetary policy rate increases does not necessarily imply that the net cash-flow channel in the euro area as a whole contributes to increased consumption in the event of interest rate increases. This reflects the fact that the overall effect on consumption also depends on the distribution of interest income and expenses and the marginal propensity to consume of these households.

Changes in net interest payments for liquidity constrained households are particularly important for monetary policy transmission, as the marginal propensity to consume of such households is high; see e.g. Holm et al. (2021) or Crawley and Kuchler (2023). The increase in net interest payments is greater for liquidity constrained households in Denmark than in the euro area; see Bovin et al. (2024).

The effect of the cash-flow channel may also depend on the extent to which household debt is issued by foreign entities and how much debt households themselves own abroad, e.g. via their pension savings. Finally, the total transmission of monetary policy transmission through the cash-flow channel is also affected by the reaction of banks and mortgage credit institutions to the net interest payments they receive. To the extent that increased net interest payments for households and businesses reflect an increase in the interest margin, this will be reflected in higher interest income and therefore higher profits for banks.

CHART 10

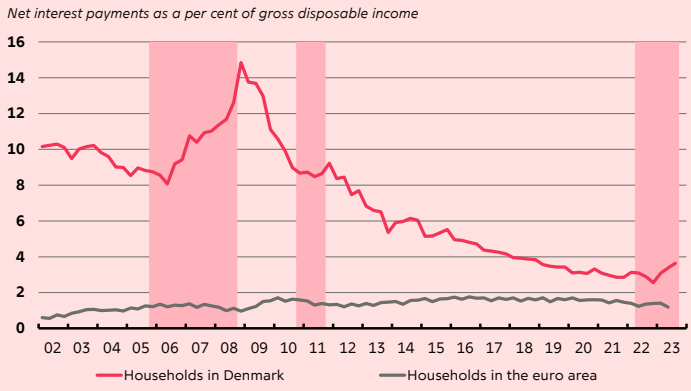
On average, Danish households have a negative unhedged interest rate exposure



Note: The definition of the unhedged interest rate exposure follows Bovin et al. (2024).
Source: Own calculations based on household-level data from Statistics Denmark and the Eurosystem's Household Finance and Consumption Survey.

CHART 11

The interest burden rises in Denmark when interest rates rise, while it decreases in the euro area



Note: The interest burden is defined as net interest expenses as a share of gross disposable income. Interest expenses and interest income are before FISM allocations. The shaded area indicates periods of rising monetary policy rates.
Source: ECB.

As described in box 1, monetary policy transmission works through many different channels, and the cash-flow channel is just one part of the overall monetary policy transmission. Therefore, a potentially stronger cash-flow channel in Denmark does not necessarily mean that the overall effect of monetary policy on activity is greater in Denmark than in the euro area, as the difference could be offset by other channels. This should be seen in light of the fact that there for example are no larger effects of interest rate changes on employment in Denmark compared to the euro area; see box 3.

03
Higher interest payments dampen household consumption

Monetary policy rate increases affect aggregate demand in the economy by, among other things, impacting household consumption through the cash-flow channel. However, the impact of changing net interest payments on total consumption depends on households' marginal propensity to consume, as discussed in the previous section. This chapter examines the part of the cash-flow channel that works through households' interest payments on their housing debt. This is the first time that the relationship between households' interest payments on housing debt and their consumption has been analysed empirically using Danish data.

In theory, the macro-level impact of changes in net interest payments may be modest, as it involves a redistribution of funds between different actors in the economy. In practice, however, the cash-flow channel will contribute to households reducing their overall consumption when interest rates rise. This applies both if interest rates on existing debt increase and if the interest rates on new loans are higher than the interest rates on the loans being repaid. The effect of the cash-flow channel reflects the fact that an interest rate increase redistributes funds from borrowers to savers, and that borrowers typically reduce their consumption more than savers increase theirs. There is evidence that this effect is significant; see e.g. Crawley and Kuchler (2023).[20]

Weaker growth in card spending can be linked to rising interest payments

In late 2022 and early 2023, rising interest rates started to impact homeowners with adjustable-rate mortgages, who experienced significant increases in their quarterly interest payments; see chart 12. However, the transmission from interest rate increases to homeowners' personal finances varies across Denmark, partly due to geographical differences in loan compositions and debt levels.

There are indications that rising loan interest rates are transmitted to household budgets faster and with greater intensity in urban areas compared to rural areas. This reflects two factors in particular. Firstly, homeowners in urban areas generally have more debt than in rural areas, and secondly, variable-rate loans and interest only loans are more common in urban areas. Unlike fixed-rate loans, interest payments on variable-rate loans are continuously adjusted, and for interest only loans, the instalments increase in a one-to-one ratio with the rising interest payments.

The geographical differences make it possible to estimate a relationship between rising interest payments and the change in consumption. Based on Danmarks Nationalbank's credit register, households' total interest payments after tax per person in all Danish municipalities are calculated quarterly from Q2 2022 to Q3 2023. Similarly, consumption per person is calculated each quarter in each municipality based on detailed data from Danske Bank on all payment card transactions. The data on consumption therefore only include card payments for

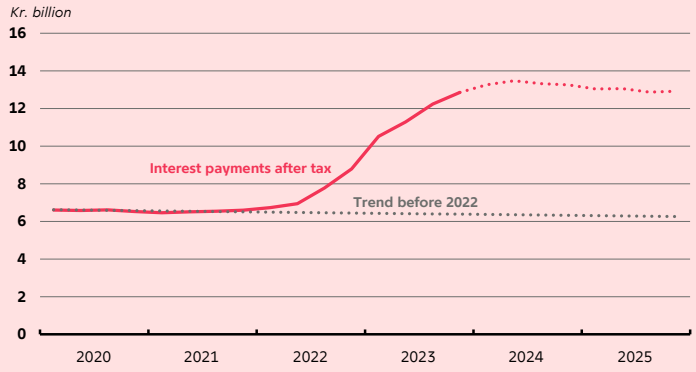
[20] In addition, households may react more strongly to losses (in this case, higher interest payments) than to gains (higher interest income). See e.g. Tversky and Kahneman (1991).

Danske Bank customers, but due to the bank's considerable size and the widespread use of card payments in Denmark, it is assumed that the observed development among Danske Bank's customers reflects the development in the rest of the country.[21]

CHART 12

Household interest expenses have doubled since 2021

Total interest and administration fee payments on Danish households' housing debt calculated after tax deductions

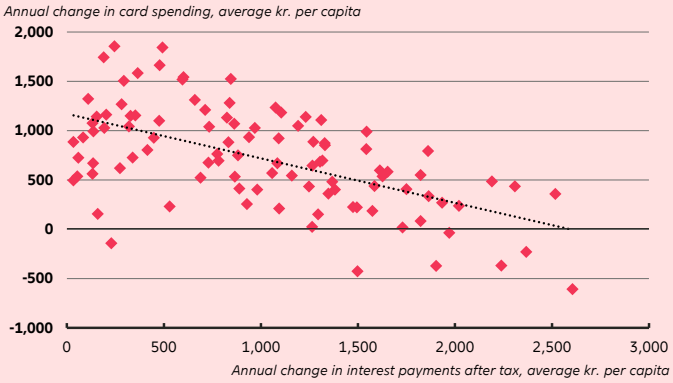


Note: Quarterly interest and administration fee payments after tax for Danish households' loans for housing purposes. Observations after 2023 (dots) indicate projected interest expenses via market-based interest rate expectations and a maintained loan portfolio. A constant replacement rate of five per cent is assumed for fixed-rate loans in each quarter.
Source: Danmarks Nationalbank.

CHART 13

Growth in card spending has been weakest in municipalities where homeowners have experienced the largest increases in quarterly interest payments on loans

Annual changes in card spending and interest payments measured as average per capita in all municipalities in Denmark



Note: The chart is a scatter plot plot of the year-on-year change in the average amount per capita for card spending against the interest payments after tax for a specific municipality in each quarter from Q2 2017 to Q2 2018. 2022 to Q3 2023. All data points are divided into 100 equal bins based on the change in interest payments, so that there are approximately the same number of observations in each bin. Adjustments are made for quarterly seasonal fluctuations within the year.
Source: Danmarks Nationalbank and Danske Bank.

Chart 13 confirms that since interest rate rises picked up from Q2 2022, card spending has developed the weakest in those municipalities where the increases in interest payments after tax has been greatest. This indicates that rising interest payments may have had a dampening effect on consumption and thus that the cash-flow channel has played a role.

Consumption effect from interest rate increases confirmed by an econometric model

The correlation between interest rate increases and consumption should be seen in light of the fact that consumption is continuously affected by a number of factors and is also influenced by the other monetary policy transmission channels described in box 1.

In addition, there may be special conditions in the individual municipalities that affect consumption in isolation and thus disrupting the correlation between the development in interest payments and consumption. This can be due to declining asset prices, including housing wealth, and the fact that some municipalities have a higher proportion of homeowners than others. Conversely, falling gas prices during the period, for example, can improve homeowners' consumption options in the municipalities where natural gas is most common. To

[21] See e.g. Andersen et al. (2022).

account for this kind of variation across the country, an econometric model is estimated that takes into account, among other things, municipality-specific conditions; see box 4.

Based on the model, a statistically significant correlation is estimated between the annual change in interest payments after tax and the annual change in card spending with a coefficient of -0.44. The estimate corresponds to households' card spending decreasing by an average of kr. 44 for every kr. 100 increase in interest payments after tax. The coefficient is estimated with a high degree of uncertainty, which is reflected in the associated wide uncertainty band, indicating that the decrease in card spending could be kr. 12-75 for every kr. 100 increase in interest payments.

Other studies find cash-flow channel effects of the same magnitude for decreasing interest rates. This applies, for example, to a study on Danish data that finds a marginal propensity to consume of 41 per cent; see Druedahl et al. (2022).[22] In another context, where Danish households gained access to liquidity when early retirement contributions could be withdrawn tax-free before retirement in 2012, a study shows that 43 per cent of the amount was used to support consumption; see Andersen (2020).

BOX 4

Estimated correlation between increasing interest payments and card spending

The empirical relationship between interest payments and consumption is estimated using quarterly data across all 98 municipalities in Denmark in a panel data regression for the municipality i at time, t

$$\Delta C_{it} = \alpha_i + \lambda_t + \beta_1 \Delta i_{it} + \beta_2 l_{it} + \beta_3 \Delta p_{it}^{Bolig} + \epsilon_{it}$$

where C denotes card spend, i is interest payments after tax, l is liquidity released from refinancing fixed-rate loans, and p^{Bolig} is the house price.[1] In the model, Δ denotes the year-on-year change, which is used here to account for seasonal changes in consumption, interest payments and house prices. The variable α_i indicates municipality-specific dummies that absorb differences in consumption across municipalities and are constant over time, and λ_t are quarter-specific dummies that absorb consumption changes that may be similar for all municipalities in a given quarter, including, for example, if some quarters are more closely linked to interest rate fixing of adjustable-rate mortgages and general seasonality in card spending. The inclusion of municipality-specific effects controls for unobservable and potentially omitted variables that relate to specific conditions for the individual municipality that are constant over time, such as tax rates, geography and, to some extent, income and wealth levels. The primary purpose of the model is to estimate the coefficient β_1, which indicates the marginal change in card spending that can be linked to changes in interest payments on debt. Everything is measured in nominal terms and is therefore not adjusted for inflation.

The regression is estimated for Q2 2022 to Q3 2023. This avoids the inclusion of the extraordinary periods of Covid and associated restrictions in the years before, while the period of significant interest rate increases is included in the data.[2] The model shows a statistically significant correlation between increasing interest payments and decreasing card spending with a coefficient of -0.44. This indicates that an increase in households' nominal interest payments after tax of kr. 100, all else being equal, was associated with a reduction in card consumption of kr. 44 in the same quarter.

Continues ...

[22] Druedahl et al. (2022) finds this marginal propensity to consume as a result of lower interest payments when adjustable-rate mortgages are fixed at a new and lower rate. A study using US data finds that the probability of buying a new car increases by 35 per cent when interest payments on variable-rate mortgages are halved. See Di Maggio et al. (2017).

... continued

	CONSUMPTION (ΔC_{it})
Δi_{it} (B_1)	-0.44**
	(0.16)
OBSERVATIONS	588
R^2	0.47

Robust standard errors shown in brackets are grouped by municipality level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

[1] Consumption, interest payments and liquidity are calculated per capita to account for changes in municipal population size.
[2] The last partial lockdown of the Danish economy was in Q1 2021, which affects the year-on-year change in consumption up to Q1 2022. Therefore, the following quarter is used as the starting point for the empirical analysis.

Based on this estimated correlation, the total reduction in card spending from 2022 to 2023 is estimated at kr. 11 billion compared to a situation where interest rates had remained at the same level as at the end of 2021; see chart 14. For 2023 alone, the decrease in consumption amounted to kr. 9 billion, corresponding to a decrease of 0.7 per cent of total private consumption in the same period.[23] This is the average estimates consumption response with an upper and lower bound of the response in 2023 of kr. 3 and 16 billion, respectively.

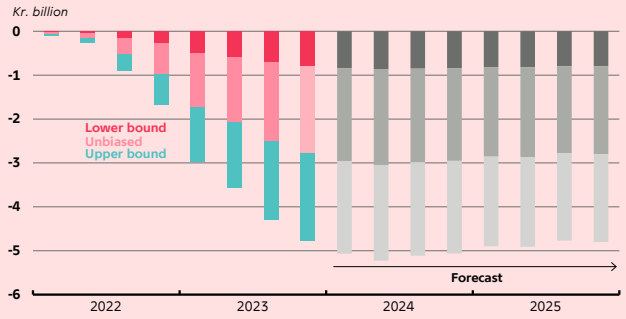
There are other factors that affect consumption in the same year. Firstly, interest income on financial assets has increased. In addition, other macroeconomic conditions have contributed to a less pronounced decline in private consumption. In particular, real wages have increased in light of falling energy prices and rising employment. Finally, it should be emphasised that, based on the econometric model, it cannot be ruled out that card spending could have fallen even if interest payments had remained unchanged during the period. Thus, the results of the model should not be interpreted causally, but rather be seen as a quantification of the potential impact of the cash-flow channel on consumption.

[23] Card spending is a subset of total household consumption. The estimate can therefore potentially be considered a lower-bound estimate of the correlation between interest payments and private consumption. On the other hand, the estimate may reflect an upper-bound estimate if the reduction in card spending is offset by an increase in other non-payment card spending. In that case there will be a substitution of consumption from goods and services paid for by payment card to goods and services paid for by other means, such as natural gas and cars.

CHART 14

Model estimates indicate an average decrease in card spending of kr. 11 billion as households' interest payments on debt have increased in 2022 and 2023

Contribution to household consumption following rising interest payments based on a statistical correlation across municipalities in Denmark

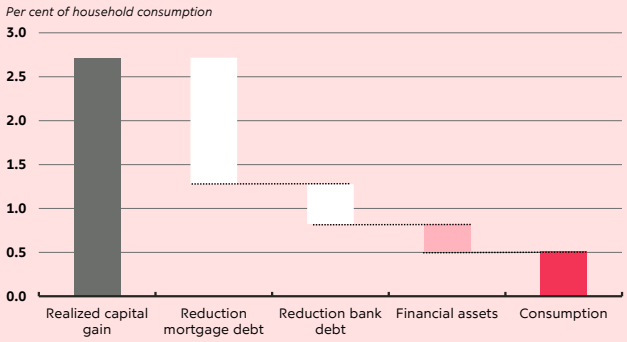


Note: The chart shows the estimated quarterly effect on consumption from households' increasing interest payments compared to a situation where the interest rate level had remained unchanged since the end of 2021. Observations after 2023 are based on projected interest payments as illustrated in chart 20.
Source: Danmarks Nationalbank.

CHART 15

Households' realised capital gains from loan refinancings in 2022 and 2023 were primarily used to repay mortgage and bank debt

Realised capital gains in isolation increased consumption in 2022-2023 by an amount corresponding to 0.5 per cent of private consumption, of which 0.4 percentage points took place in 2022



Note: Realised capital gains reflect the decrease in the market price of existing fixed-rate mortgage loans that were repurchased by the borrower in Q1. 2022 to Q4 2023. The reduction in bank debt, savings in financial assets and increased consumption in connection with loan refinancing reflects the fact that the new loan is larger than the market value of the original loan, which means that there is additional borrowing.
Source: Danmarks Nationalbank and Statistics Denmark.

The estimated correlation between increasing interest payments and decreasing card spending should be seen in light of the other monetary policy transmission channels described in box 1. This study should primarily be seen as a quantification of the largest component of the net interest payment channel, namely the part that relates to actual changes in interest payments on household debt. The more general effects of interest rate increases through the intertemporal substitution channel and the wealth channels are likely to be largely reflected in the general consumption development at the national level and therefore cannot be identified from variation across municipalities.

Loan refinancing offers only limited support to consumption

A special feature of the Danish mortgage credit system means that interest rate increases can potentially lead to increased household consumption. More specifically, a rise in interest rates makes it possible to refinance existing fixed-rate mortgages with a capital gain. This can free up liquidity and thus support consumption, as the homeowner can choose to mortgage the capital gain. Repurchases of fixed-rate mortgage loans have secured Danish households realised capital gains of kr. 66 billion in Q1-Q3 2018. 2022 to Q4 2023. This corresponds to 2.9 per cent of total private consumption in the same period; see chart 15.

According to Danmarks Nationalbank's credit register, mortgage debt and bank debt have been reduced by kr. 35 and 11 billion, respectively, in connection with refinancing. This means that the annual growth in total lending to households at the end of 2023 would have been 0.7 percentage points higher than the actual growth rate of 0.4 per cent. The realised capital gains have thus contributed significantly to reducing the growth in total lending to households.

The remaining amount from the capital gains of kr. 20 billion, which has not been used to reduce outstanding debt, has been released as liquidity to households. It is estimated that the majority of this liquidity, approximately kr. 12 billion, has been spent on increased consumption in the same period; see box 5. This corresponds to 0.5 per cent of total household consumption in the same period. This means that kr. 8 billion has been saved as liquid savings, including deposits, and invested in shares and bonds. The kr. 8 billion can be used by households to support consumption in the coming years.

In this way, the loan refinancings already made are assessed to have limited consequences for future consumption, even though they may contribute to increased consumption in isolation. In the event of new interest rate increases, a new wave of refinancings could unfold among households. However, the extent is expected to be lower than in the previous few years, as far fewer outstanding fixed-rate loans have a sufficiently low coupon to provide significant capital gains in the event of further interest rate increases.

BOX 5

Estimated consumption effect from refinancings of fixed-rate mortgages in 2022

The starting point is consumer identity

$$C_{i,t} = I_{i,t} - \Delta NW_{i,t},$$

which for each household i indicates consumption, $C_{i,t}$, available liquidity, $I_{i,t}$, and annual change in net savings, $\Delta NW_{i,t}$, at the time t. The identity can be extended to the following components of the household's financial balance sheet

$$C_{i,t} = Y_{i,t} + B_i - \mathrm{AF}_{i,t} + \Delta G_{i,t} - \Delta S_{i,t},$$

where $Y_{i,t}$ is disposable income, B_i is realised capital gain[1], $S_{i,t}$ is gross savings including private pension contributions, measured after tax, $AF_{i,t}$ is mortgage debt repayments, and $G_{i,t}$ is bank debt.

The withdrawn liquidity from the mortgage refinancing can be defined as the capital gain less any reduced debt in banks and any repayments on mortgage debt during the year after the refinancing

$$L_{i,t} = B_i - \mathrm{AF}_{i,t} + \Delta G_{i,t}.$$

The marginal change in consumption out of withdrawn liquidity can then be written as

$$\frac{\partial C_{i,t}}{\partial L_i} = 1 - \frac{\partial \Delta S_{i,t}}{\partial L_i},$$

where the right-hand side can be estimated based on registry data. The regression is specified as a difference-in-differences model

$$y_{i,t} = \alpha + \beta_1 Post_t + \beta_2 Cohort_i + \beta_3 Post_t \times Cohort_i + \omega_i + \gamma_t + \gamma_t \times kupon_i + \varepsilon_{i,t},$$

where $y_{i,t}$ is the dependent variable for household i at the time t, $Post_t$ is a dummy variable that has a value of one in year 2022 and a value of zero in all previous years. The variable $Cohort_i$ is a dummy variable that takes the value one for households that refinanced their existing fixed-rate mortgage in 2022, and takes the value zero for households that made a similar refinancing in Q1-Q3. 2023. The cohort of borrowers who refinanced just before the turn of the year can thus be characterised as the treatment group, while the other cohort that refinanced after the turn of the year can be used as the control group. The control group is made up of borrowers who make the exact same type of mortgage refinancing as the treatment group, but they refinanced up to one year later. In other words, the two cohorts should be similar across a number of characteristics and differ only in the timing of their refinancing. Since the coupon rate of their original mortgage will correlate with the timing of their refinancing, households' coupon rates are included as control variables, interacted with year dummies, γ_i. The interaction will absorb the variation that the original coupon rate can explain over time. Household dummies, ω_i, absorb household-specific variation in the regression, which does not vary over time.

Continues ...

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This includes, for example, the age at the time of the mortgage refinancing and the geographical location of the property, but it also includes unobservable characteristics such as preferences, including whether the household can be described as impatient and risk-taking.

The study comes with a number of caveats. The type of homeowners who refinanced in 2022 may differ from the type of homeowners who did the same in 2023. For example, the former group may be more impatient and prioritise spending today over spending in the future. This may contribute to the study overestimating the impact of refinancing on total private consumption, as the marginal propensity to consume will be higher for homeowners who refinanced their homes sooner rather than later. In the study, it cannot be ruled out that homeowners would have refinanced their mortgages even in the absence of the interest rate increases and the recent capital gains. This will also tend to overestimate the impact of refinancings on private consumption. Both of these factors mean that the estimated consumption out of realised capital gains can be interpreted as an upper-bound estimate.

	LIQUIDITY (L)	SAVINGS (ΔS)
POST X COHORT (B_3)	125,418***	47,153***
	(2,051)	(2,017)
OBSERVATIONS	738,780	738,780
R^2	0.099	0.081

Robust standard errors clustered at household level in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

The consumption quota can be calculated from the estimated behavioural changes in the table

$$\frac{\partial C_{i,t}}{\partial L_{i,t}} = 1 - \frac{47.153}{125.418} = 0{,}624$$

This indicates that the consumption effect of refinancing fixed-rate mortgages in 2022 accounted for 62 per cent of the released liquidity. The released liquidity for 2022 and 2023 is estimated at kr. 20 billion in the same years.[2] This means that the estimated consumption effect of mortgage refinancing, which is linked to rising mortgage rates, was approximately kr. 12 billion, which corresponds to 0.5 per cent of private consumption in the same period.

[1] The capital gain includes changes in the mortgage debt in connection with the mortgage refinancing. A negative capital gain thus reflects a reduction in the remaining debt, while a positive capital gain is released liquidity.
[2] Also see Andersen et al. (2024) for further description of the mortgage refinancing.

Bibliography

Amatyakul, Pongpitch, Fiorella De Fiore, Marco Lombardi, Benoit Mojon and Daniel Rees (2023), The contribution of monetary policy to disinflation, *BIS Bulletin*, No. 82.

Andersen, Asger Lau, Emil Toft Hansen, Niels Johannesen and Adam Sheridan (2022), Consumer Responses to COVID-19 crisis: evidence from bank transaction data, *Scandinavian Journal of Economics*, 124(4), pp. 905-929.

Andersen, Asger Lau, Niels Johannesen, Mia Jørgensen and José-Luis Peydró, (2023), Monetary Policy and Inequality. *Journal of Finance*, 78: 2945-2989.

Andersen, Henrik Yde (2020), Spending when illiquid savings become liquid: Evidence from Danish wage earners, *Danmarks Nationalbank Working Paper*, no. 161, September.

Andersen, Henrik Yde and Søren Leth-Petersen (2021), Housing wealth or collateral: How home value shocks drive home equity extraction and spending, *Journal of the European Economic Association*, vol. 19(1).

Andersen, Henrik Yde, Stine Ludvig Bech, Simone Maria Bonin and Andreas Kuchler (2023), Pension Wealth Returns in Danish Households, *Danmarks Nationalbank Economic Memo*, No. 8, December.

Andersen, Henrik Yde, Erik Grenestam, Marcus Bjerregaard Læssøe, Alexander Meldgaard Otte and Sigurd Anders Muus Steffensen (2024), Rising interest rates and household refinancing of fixed-rate mortgage loans, *Finans/Invest*, no. 1.

Aruoba, S. Boragan and Thomas Dreschel (2023), *Identifying Monetary Policy Shocks: A Natural Language Approach*, mimeo.

Auclert, Adrien (2019), Monetary Policy and the Redistribution Channel, *American Economic Review,* 109(6), pp. 2333-2367.

Auclert, Adrian, Matthew Rognlie and Ludwig Straub (2020), Micro Jump, Macro Humps: Monetary Policy and Business Cycles in an Estimated HANK Model, *NBER Working Paper,* nr. 26647.

Auclert, Adrian, Matthew Rognlie, Martin Souchier and Ludwig Straub (2021), Exchange Rates and Monetary Policy with Heterogeneous Agents: Sizing up the Real Income Channel, NBER Working Paper, nr. 28872.

Badinger, Harald and Stefan Schiman (2023), Measuring Monetary Policy in the Euro Area Using SVARs with Residual Restrictions, *American Economic Journal: Macroeconomics*, 15(2).

Banerjee, Ryan, Julián Caballero, Enisse Kharroubi, Renée Spigt and Egon Zakrajšek (2023), Interest rate risk of non-financial firms: who hedges and does it help?, *BIS Bulletin,* No 81.

Bernanke, Ben S. and Mark Gertler (1995), Inside the Black Box: The Credit Channel of Monetary Policy Transmission, *Journal of Economic Perspectives*, 9(4).

Bernanke, Ben S., Mark Gertler and Simon Gilchrist (1999), The financial accelerator in a quantitative business cycle framework, *Handbook of Macroeconomics*, chap. 21.

Bhutta, Neil and Benjamin J. Keys (2016), Interest Rates and Equity Extraction during the Housing Boom, *American Economic Review*, vol. 106(7).

Bovin, Andreas, Mia Jørgensen, Andreas Kuchler, Jacob Wiberg Larsen, Marcus Bjerregaard Læssøe and Alexander Meldgaard Otte (2024), The household cash-flow effects of monetary policy in Denmark and the euro area, *Danmarks Nationalbank Economic Memo*, No. 1, January.

Bundick, Brent and A. Lee Smith (2020), The Dynamic Effects of Forward Guidance Shocks, *The Review of Economics and Statistics*, 102(5).

Caldara, Dario and Edward Herbst (2019), Monetary Policy, Real Activity, and Credit Spreads: Evidence from Bayesian Proxy SVARs, *American Economic Journal: Macroeconomics*, 11(1).

Caravello, Tomás E., Alisdair McKay and Christian K. Wolf (2024), *Evaluating Policy Counterfactuals: A "VAR-Plus" Approach*, mimeo.

Cesa-Bianchi, Ambrogio, Gregory Thwaites and Alejandro Vicondoa (2020), Monetary policy transmission in the United Kingdom: A high frequency identification approach, *European Economic Review*, 123.

Christiano, Lawrence J., Martin Eichenbaum and Charles L. Evans (1999), Monetary policy shocks: What have we learned and to what end? *Handbook of Macroeconomics*, vol 1A.

Cloyne, James and Patrick Hürtgen (2016), The Macroeconomic Effects of Monetary Policy: A New Measure for the United Kingdom, *American Economic Journal: Macroeconomics*, 8(4).

Coenen, Günter, Peter Karadi, Sebastian Schmidt and Anders Warne (2019), The New Area-Wide Model II: an extended version of the ECB's micro-founded model for forecasting and policy analysis with a financial sector, *ECB Working Paper Series*, No 2200.

Coibion, Olivier (2012), Are the Effects of Monetary Policy Shocks Big or Small? *American Economic Journal: Macroeconomics*, 4(2).

Crawley, Edmund and Andreas Kuchler (2023), Consumption heterogeneity: Micro drivers and macro implications, *American Economic Journal: Macroeconomics*, vol. 15(1), pp. 314-341.

Crump, Richard, Marco Del Negro, Keshav Dogra, Pranay Gundam, Donggyu Lee, Ramya Nallamotu and Brian Pacula (2023), The New York Fed DSGE Model Perspective on the Lagged Effect of Monetary Policy*, Liberty Street Economics, Federal Reserve Bank of New York*.

Danmarks Nationalbank (2024), Pengepolitikken er stram og dæmper inflationen, *Danmarks Nationalbank Analyse (Monetære og finansielle tendenser),* no. 3, March

D'Amico, Stefania and Thomas B. King (2023), What does anticipated monetary policy do? *Journal of Monetary Economics*, 138.

de Bondt, Gabe, Georgi Krustev, Michal Slavik and Mika Tujula (2023), Net interest income of households and firms, *ECB Economic Bulletin*, issue 8.

Del Negro, Macro, Marc P. Giannoni and Frank Schorfheide (2015), Inflation in the Great Recession and New Keynesian Models, *American Economic Journal: Macroeconomics*, 7(1).

Di Maggio, Marco, Amir Kermani, Benjamin J. Keys, Tomasz Piskorski, Rodney Ramcharan, Amit Seru and Vincent Yao (2017), Interest Rate Pass-Through: Mortgage Rates, Household Consumption, and Voluntary Deleveraging, *American Economic Review*, 107(11), pp. 3550-88.

Drejer, Peter Askjær, Marianne Clausager Koch, Morten Hedegaard Rasmussen, Morten Spange and Søren Vester Sørensen (2011), How does monetary policy work in Denmark?, *Danmarks Nationalbank* Monetary *Review*, 2nd Quarter, Part 2.

Druedahl, Jeppe, Emil B. Jensen and Søren Leth-Petersen (2022), The Intertemporal Marginal Propensity to Consume out of Future Persistent Cash-Flows: Evidence from Transaction Data, *University of Copenhagen Department of Economics Discussion Paper*, no. 13.

Fehr, Ernst and Jean-Robert Tyran(2001) , Does Money Illusion Matter?, *American Economic Review*, 91(5), pp. 1239-1262**.**

Gürkaynak, Refet, Brian Sack and Eric T. Swanson (2005), Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements, *International Journal of Central Banking*, 1(1).

Harr, Thomas and Morten Spange (2023), Inflation – why did it rise and what are the drivers ahead?, *Danmarks Nationalbank Economic Memo*, No. 3, February.

Holm, Martin Blomhoff, Pascal Paul and Andreas Tischbirek (2021), The Transmission of Monetary Policy under the Microscope, *Journal of Political Economy*University of Chicago Press, vol. 129(10), pp. 2861-2904.

Hviid, Simon Juul and Andreas Kuchler (2017), Consumption and savings in a low interest-rate environment, *Danmarks Nationalbank Working Paper*, No. 116, June.

Jarocinski, Marek and Peter Karadi (2020), Deconstructing Monetary Policy Surprises – The Role of Information Shocks, *American Economic Journal: Macroeconomics*, 12(2).

Jensen, Jakob Roager, Jakob Guldbæk Mikkelsen and Morten Spange (2017), The ECB's unconventional monetary policy and the role of exchange rate regimes in cross-country spillovers, *Danmarks Nationalbank Working Paper*, No. 119, October.

Kaplan, Greg and Giovanni L. Violante (2014), A model of the consumption response to fiscal stimulus payments, *Econometrica* 82, no. 4, pp. 1199-1239.

Kaplan, Greg, Benjamin Moll and Giovanni L. Violante(2018) ,Monetary Policy According to HANK, *American Economic Review*, 108(3), pp. 697-743**.**

Kristoffersen, Mark Strøm and Morten Spange (2016), Exchange rate pass-through to Danish import and consumer prices, *Danmarks Nationalbank Monetary Review*, Q1 2016.

Kuttner, Kenneth N. (2001), Monetary Policy Surprises and Interest Rates: Evidence from the Fed Funds Futures Market, *Journal of Monetary Economics*, 47(3).

Lane, Philip (2022), *The transmission of monetary policy*, Speech at the SUERF, CGEG|COLUMBIA|SIPA, EIB, SOCIÉTÉ GÉNÉRALE conference on "EU and US Perspectives: New Directions for Economic Policy", New York, October.

Lane, Philip (2023), *The euro area hiking cycle: an interim assessment*, Dow Lecture at the National Institute of Economic and Social Research, London, February.

Larsen, Rasmus Bisgaard and Christoffer Jessen Weissert (2024), Monetary policy transmission in Denmark, *Danmarks Nationalbank Working Paper*, No. 198, January.

Laséen, Stefan (2020), Monetary Policy Surprises, Central Bank Information Shocks, and Economic Activity in a Small Open Economy, *Sveriges Riksbank Working Paper Series*, no. 396.

Mandsberg, Rasmus Kofoed, Søren Lejsgaard Autrup, Lars Risbjerg (2016), Pass-through from *Danmarks National*bank to bank interest rates, *Danmarks Nationalbank Monetary Review*, 2nd Quarter 2016

Miranda-Agrippino, Silvia and Giovanni Ricco (2021), The Transmission of Monetary Policy Shocks, American Economic Journal: *Macroeconomics*, 13(3).

Ramey, Valerie A. (2016), Macroeconomic Shocks and Their Propagation, i: John B. Taylor and Harald Uhlig (eds.), *Handbook of Macroeconomics*, Vol. 2A.

Romer, Christiana D. and David H. Romer (2004), A New Measure of Monetary Shocks: Derivation and Implications, *American Economic Review*, 94(4).

Shafir, Eldar, Peter Diamond and Amos Tversky (1997), Money Illusion, *The Quarterly Journal of Economics* 112, no. 2, pp. 341-74.

Sims, Christopher A. (1986), Are Forecasting Models Usable for Policy Analysis? *Federal Reserve Bank of Minneapolis Quarterly Review*, 1986.

Smets, Frank and Raf Wouters (2003), An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area, *Journal of the European Economic Association*, 1(5).

Spange, Morten (2022), Monetary and Fiscal Policy in Denmark, *Danmarks Nationalbank Analysis*, No. 12, October.

Swanson, Eric T. (2023), The Macroeconomic Effects of the Federal Reserve's Conventional and Unconventional Monetary Policies, *NBER Working Paper Series*, No. 31603.

Tversky, A., & Kahneman, D. (1991), Loss Aversion in Riskless Choice: A Reference-Dependent Model, *Quarterly Journal of Economics*, 106(4), pp. 1039-1061.

Uhlig, Harald (2005), What are the effects of monetary policy on output? Results from an agnostic identification procedure, *Journal of Monetary Economics*, 52(2).

Wolf, Christian K. (2020), SVAR (Mis)identification and the Real Effects of Monetary Policy Shocks, *American Economic Journal: Macroeconomic*, 12(4).

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